U.S. UTILITY PATENT APPLICATION

for

"CONNECTOR"

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claiming priority from:

German Application No. 102 28 950.6 filed 28 June 2002

and

German Application No. 102 30 376.2 filed 5 July 2002

Attorney Docket No.: 111427-00603/AT02011

DESCRIPTION:

CONNECTOR

TECHNICAL FIELD

The present invention relates to a connector, and in particular to a plug-in connector. The invention also relates to a connection system formed by two connectors.

BACKGROUND

Connectors are frequently used to provide electrical connections of all kinds. Plug-in connections formed by a first connector and a second connector in the form of a plug-in connector are frequently used in connection with switch cabinets. Generally speaking, switch cabinets comprise a plurality of said first connectors which are mounted at a frame of a switch cabinet in a predetermined position defining a plug-in direction. Second connectors in the form of plug-in connectors are, for instance, provided at one or more drawer(s) which can be pushed into and out of the switch cabinet. The movement of a drawer into the switch cabinet provides for a plug-in motion of a second connector mounted on the drawer into a first connector mounted at the frame of the switch cabinet. The engagement of the first connector with the second, or plug-in, connector provides for a desired connection system.

Due to various reasons, during the operating life of said connectors, misalignments occur between the respective first and second connectors. In case such a misalignment occurs, the desired connection is either not possible, or is difficult to achieve. For this reason, plug-in connections were developed which are provided with circular catching regions which will provide, within certain tolerances, for proper plug-in connections at the time a drawer is moved into the frame of the switch cabinet.

However, the use of the circular catching areas requires a certain amount of space on the connectors which is consequently lost for other purposes.

SUMMARY OF THE INVENTION

In a first embodiment of the invention, a plug-in connection is provided using a first connector adapted to be mounted on a frame of a switch cabinet, and a second connector mounted on a drawer adapted to be pushed into and pulled out of said cabinet. According to the first embodiment of the present invention, one of the said first and second connectors is provided with a catch area of rectangular shape. According to a second embodiment of the invention, the catching area is of square shape.

In accordance with the invention, a catching area of ±2.5 mm can be realized using up a minimum of space.

In a further embodiment of the invention, a balance of the tolerances can be obtained in all directions by providing that a catching surface defining the catching area is asymmetrical, i.e. the catching surface defined by the catching area in the form of a conus, at the end of which, in plug-in direction, a catching hole is provided with the conus- or funnel-shaped catching surface being asymmetric, i.e. the catching hole being located close to the lower side of the catching area.

In a further embodiment of the invention, it is provided that the second, or plug-in, connector, is mounted movably with respect to the drawer, so as to provide for a stroke, allowing a relative translational movement between the second connector and the drawer. Due to the stroke length, the plug-in connection between the first and the second connectors will not be immediately released if the drawer is pulled out of the frame of the switch cabinet, but has to carry out first the stroke whereupon then the plug-in connection will be separated.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic view onto the guide or catching area of a first connector typically mounted at the frame of a switch cabinet.

Figure 2 is a top plan view onto the connecting surface of a first connector having four catching areas according to the invention;

Figure 2A is a side elevation view of a bolt used in the invention.

Figure 3 is a view similar to Figure 2,. showing schematically the insertion of guide pins;

Figure 4 is an enlarged view of the plug-in side of a second connector mounted in the frame and showing a square with a funnel- or cone-shaped surface having a guide hole at the bottom of the funnel;

Figures 5-7 show schematically different guide or catching situations for the second connector;

Figure 8 shows a perspective view of a connector body of a first, female connector adapted to be mounted on the frame of a switch cabinet;

Figure 9 is a top plan view of the connector Figure 8;

Figure 10 is a perspective schematic representation of a second connector, also called a plug-in connector, which is adapted to be mounted on a drawer, a part of which is shown schematically;

Figure 11 is a top plan view of the connector of Figure 10;

Figure 12 shows a part of a frame of a switch cabinet with a first, female, connector mounted thereon, and with a second, male, or plug-in, connector slidably mounted on a part of a drawer;

Figure 13 discloses the partial insertion of the second, male connector in the first, female connector;

Figure 14 discloses the plug-in connection system in its final position;

Figure 15 discloses the first stage of removal of the second, or plug-in, connector from the female connector with the part of the drawer having moved the complete length of a stroke, so that a continued movement of the part of the drawer would remove the second, or plug-in, connector from the first, or female, connector as it is shown in Figure 16. Figure 16 shows the female connector and the male connector not forming a plug-in connection system anymore.

DETAILED DESCRIPTION

Initially, reference will be made to Figures 12 and 14, which disclose a perspective view of a part 500 of a frame 8 of a switch cabinet, and also a part 600 of a drawer 9. The drawer 9 is adapted to be pushed into the switch cabinet. During this movement the drawer 9 is guided, by guide means which are not shown, but are provided between part 500 and part 600. A first, or frame, connector 11 in the form of a female connector is mounted to part 500 of the frame. For cooperation with the first connector 11, a second, or drawer, connector 12, in the form of a male connector, also called a plug-in connector, is mounted on part 600. The drawer connector 12 further cooperates with two guide pins 30 and 31, which are received in respective guide holes 731 and 732 (see Figures 10 and 11), provided by the drawer connector 12.

As shown in Figure 14, a connection system 10 is formed by the frame connector 11 and the drawer connector 12, after the drawer connector 12 has been fully inserted into the frame connector 11.

The frame connector 11 is movably mounted at the frame part 500 for movement in a plane perpendicularly with respect to the plug-in and pull-out (short: plug) direction, indicated by arrow 2 in Figure 14. The drawer connector 12 is translationally movably mounted within and relative to drawer part 600 of the drawer 9, in said plug direction 2, i.e. the drawer connector 12 is reciprocally moveably mounted in part 600, but is not movable perpendicularly to the plug direction 2.

The frame connector 11 comprises a first insulating body 13 adapted to receive contact elements which are not shown. The first insulating body 13 will be referred to below as female, or simply as a frame insulating body 13, inasmuch as in the preferred embodiment shown and described, the frame connector 11 carries female contact elements. The drawer connector 12 comprises a second insulating body 14, which will be referred to below as a male, or simply as a drawer insulating body 14, because in the shown preferred embodiment, the drawer connector 12 uses male contact elements. It is clear for the person skilled in the art that the design of

the connection or connection system 10 could be different, i.e. the frame connector 11 could be designed as a male connector and the drawer connector 12 could be designed as a female connector.

Following this introductory note concerning the environment within which the invention is used, attention is now drawn to Figure 1, which schematically discloses a top plan view of a catching, or guiding, area 20 provided on e.g. a frame insulating body. The catching area 20 is required for the following reasons. When establishing a plug-in connection like connection 10 between a first, or frame, connector and a second, or drawer, connector, it is necessary to properly align both connectors, so that the respective female contact elements and male contact elements achieve proper engagement. To a certain degree, the prior art as represented by Figure 1, obtains with the circular catching area 20 some guidance for achieving said connection.

Assuming (see Figure 1) that at the frame connector a catching area of ±2.5 mm in x and y directions had to be realized, for the full tolerance in x and y direction, the circle 20, forming the outer perimeter of the catching area 20, would have to be so large that the guide pins provided at the drawer connector would still be caught by the catching area 20 of the frame connector. If the prior art, for instance, provides, as shown in Figure 1, a circular catching area 20 with the diameter of 5 mm, then no tolerance of ±2.5 mm in x and y direction is admissible. For an area of tolerance of ±2.5 mm in x and y direction, a circle is required which has a significantly larger diameter D than 5 mm. The consequence is that otherwise useful space is lost on the frame insulating body. By providing, in accordance with the invention, a rectangular or square catching area 21, a catching area of ±2.5 mm can be realized with the least possible amount of space being lost.

Figure 2 is a top plan view of a frame insulating body 13, according to a preferred embodiment of the invention, which comprises a substantially square catching area 21, at the bottom end of which guide holes 26 are shown. Figure 2 shows further the influence of gravity. As can be seen, the frame insulating body 13 is adapted to be floatingly supported at frame part 500 (not shown in Figure 2). The frame insulating body 13 is supported on bolts 23, which are threadedly connected

with the frame part 500. As can be seen in Figure 2A, each of the two bolts 23 used in the embodiment shown in Figure 2 comprises a head 24 and a support section 25, on which the frame insulating body 13 rests. The bolt 23 also has a threaded end by means of which bolt 23 is fixedly connected to the part 500 of the frame.

Both Figures 2 and 4, the latter of which shows an enlarged portion of Figure 2, disclose a tapered guide or catching surface 22 (also called funnel- or cone-shaped) leading to a guide and receiving hole 26, adapted to receive one of said guide pins 30, 31.

Figure 3 discloses, in accordance with an embodiment of the invention, a frame insulating body 130, having a rectangular catching area 202 without the asymmetric design of the catching surfaces 22 of the catching area 21, as shown in Figure 2. Figure 3, like Figure 2, discloses that the frame insulating body 130 is provided with cutouts 27 and 28, allowing for a certain movement of the frame insulating body 13 in a plane perpendicular to plug direction 2. Within the cutouts 27 and 28, each one bolt 23 is located, of which only the support section 25 is shown. The catching surfaces 202, defining the catching area 200, extend symmetrically into the plane of the drawing towards a guide and receiving hole 260 for one of the guide pins 30, 31, provided on the drawer.

As is shown in Figure 3, there are nine positions referred to by numbers 1-9, which represent positions which the guide pin 30, and in a preferred embodiment the two guide pins 30, 31, can assume when the drawer 9 is moved into the switch cabinet. These nine positions show different positions of misalignment. For the positions 1-6 of the guide pins 30, 31, an alignment will be possible at the time the pins 30, 31, reach the catching area 200. For the positions 7-9, an alignment is not possible, inasmuch as this would require a downward movement of the frame insulating body 130, so that the arriving guide pins 30, 31 could enter the guide holes 260. A movement of the frame insulating body 130 downward is not possible because the frame insulating body 130 is already in abutment with the upper sides of the areas of movement defined by the cut outs 27, 28, which abut at the support sections 25 of the bolts 23.

To overcome the disadvantage of the just-described embodiment of the invention, the preferred embodiment is provided in Figures 2 and 4. An asymmetric catching or guide surface 22, also called an asymmetric catching funnel or cone, which is provided by the frame insulating body 13, in which the catching holes 26 are located adjacent to the lower perimeter section 222 of the catching area (see Figure 4).

Each of Figures 5-7 disclose in each of the respective left sketches a frame insulating body 13 located in a center position. In case a drawer, together with a drawer connector, represented here only by the two guide pins 30, 31, is moved towards said frame insulating body 13, depending on the kind of misalignment, different "catching positions" are shown in the right-hand sketches of Figures 5-7. These Figures 5-7 disclose in the right-hand sketches some of the relative positions of the frame insulating body 13, with respect to the support section 25 of each of said bolts 23.

Figures 8 and 9 are, respectively, perspective and top plan views of the frame insulating body 13. The frame insulating body 13 comprises a base section 130 in which the cutouts 27 and 28 are provided. The cutouts 27, 28 are preferably square-shaped and adapted to receive, as is shown in Figure 9, the bolts 23, of which the support section 25 is schematically shown.

Projecting perpendicularly away from the base section 130, as is shown in Figure 8, tube-shaped elements 131 are provided which are adapted to receive preferably female contact elements. Further, approximately square-shaped elements 132 are formed diagonally opposite to each other at the base section 130, forming in their free end the catching surfaces 22 of asymmetrical design, as was explained in connection with Figure 4. The catching surfaces 22 end in catching holes 26.

Figures 10 and 11 disclose the drawer insulating body 14 which also comprises tube-shaped elements 141 adapted to receive male contact elements, i.e. contact pins, not shown. The tube-shaped elements 141 extend perpendicularly from a surface of a substantially square-shaped surface of a base section 33 from which a support section 34 projects away in the opposite direction. In the base section 33 of

the drawer insulating body 14, the guide pin holes 731, 732 are provided which extend through the base section 140 in plug-in direction 2, as referred to in Figure 14. The support section 34 has a substantially rectangular cross-section and has the form of a parallelepiped. It is located about centrally at the base or head section 33. The head section 33 defines adjacent to the location where the support section 34 extends from the head section 33 abutment surfaces 36. The upper surface of the head section 33 is provided with an arrow 38 of orientation.

Figure 10 discloses, as do Figures 12-16, that the support section 34 of the drawer insulating body 14 has a predetermined length which provides for a certain amount of stroke length L, as shown in Figure 15. One end of the stroke length L is defined by resilient detent hooks 50. Preferably, as shown in Figure 16, the resilient detent hooks 50 are located diametrically opposite to each other, i.e. on the upper and lower right-hand corners of the free end. (Figure 10) of the support section 34. The resilient detent hooks 50 make it possible for the drawer to be placed on the support section 34, or stated differently, the support section 34 can be inserted in a respective rectangular hole 60 (Fig. 12) provided in the drawer part 600. This placement process is simplified by detent guide surfaces 52, which are inclined and cause the detent hooks 50 to resiliently move inwardly during the insert operation of the support section 34 into the hole 60 of the part 600 of the drawer. The shape of the opening 60 corresponds to the shape of the support section 34 to readily receive said support section 34, allowing for a relative movement between the support section 34 and part 600, as is shown in Figures 12-16.

As is shown, for instance in Figure 16, the part 600 of drawer 9 is provided with the two earlier-mentioned guide pins 30, 31 in the following manner. The guide pins 30, 31 are mounted at part 600 of the drawer 9, by means of nuts 310 (only one is shown). The guide pins 30, 31 project through the openings 731, 732 in the base section 33 of the drawer insulating body 14 and extend out of said openings 731, 732 as is shown in Figure 12. By means of said guide pins 30, 31, which project away from the drawer insulating body 14 in plug-in direction 2, provided the misalignment between the drawer insulating body 14 and the frame insulating body 13 is not too great, alignment can be achieved. The free ends of the guide pins 30, 31 will engage within the asymmetric catching area 22, i.e. the catching surface and will move, if no

perfect alignment is present, the frame insulating body 13 in the same manner as shown in Figures 5-7.

A continued translational movement of the drawer (a part of which is shown at 600) towards the part 500 of frame 8 of the switching cabinet will eventually lead to an engagement between the female contacting elements of the frame connector 11 and the male contact elements of the drawer connector 12, as is shown in Figure 14. This engagement will be caused by the pushing force of the operator imparted upon the handles at the drawer 9 to the drawer connector 12 by the interaction of the part 600 of the drawer 9 coming into engagement with the abutment surfaces 36 of the drawer connector 12.

So as to make it possible that the drawer 9 can be moved by a certain amount out of the contact position shown in Figure 14, however without opening the plug connection between the frame connector 11 and the drawer connector 12, the drawer insulating body 14 is provided with said parallelepiped-shaped section 34, having detent hooks 50. The length of said support section 34, together with the position of the detent hooks 50, define the possible stroke length L, which is available when withdrawing the drawer 9 from the position shown in Figure 14.

The opening or unplugging of the plug-in connection 10 can occur after the defined stroke length L has been traveled. After the defined stroke, the drawer insulating body 14 will be pulled out of the frame insulating body 13, thus opening the connection between the female and male contact elements in the respective insulating bodies. Prior art designs, however, require numerous individual components and a costly assembly process, which will lead to expensive connectors.

By the integration of the detent hooks 50 in the plastic material forming the drawer insulating body 14, it is possible to provide for the stroke length L without additional components. During assembly, the drawer insulating body 14 is inserted with its free end through the hole 60 into the part 600 of the drawer, such that the detent hooks 50 are depressed and then spring back into their original position, thus mounting the drawer insulating body 14 on the part 600 of the drawer 9.

As referred to above, the two guide pins 30, 31 are inserted into the guide holes 731, 732 of the support section 34, and the ends of the guide pins opposite to the free ends, or plug-in ends are mounted at the drawer 9, preferably by a thread connection as shown in Figure 15. For this purpose, the ends of the guide pins 30, 31 which extend to corresponding holes in the drawer 9 are provided with threads, onto which the nuts 310 are screwed, to fixedly mount the guide pins 30, 31 at drawer 9, as shown at 301 and 302 in Figure 15. Thus, the drawer insulating body can reciprocate on the guide pins 30, 31. The relative translational movement between support section 34 and part 600 is limited on the one hand side by the abutment surfaces 36 and on the other hand side by abutments 51 formed by the detent hooks 50. As is shown, the detent hooks 50 have a spring arm which extends in longitudinal, or plug-in direction. At the free end of the spring arm, a detent nose is provided which forms the detent guide surface 52 and the abutment surface 51.